REMARKS

Claims 1-11, 13-15, 17, 18 and 21-35, are all the claims presently pending in the application. Claims 1-11, 13-15, 17, 18 and 21-35 stand rejected on prior art grounds. Reconsideration is respectfully requested.

Claims 1-11, 13-15, 17, 18, 22, 23, 25 and 28-35 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Muramatsu (JP 05-323355) in view of Kang (U.S. Patent No. 6,559,522). Claims 21, 24, 26 and 27 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Muramatsu (JP 05-323355) in view of Kang as applied to claims 1-9, 22, 23, 25 and 28-35, and further in view of Toyosawa, et al. (U.S. Pub. 2002/0033524).

These rejections are respectfully traversed in view of the following discussion.

Entry of this § 1.116 Amendment is proper. Since the amendments above narrow the issues for appeal and since such features were in the claims earlier, such amendments do not raise a new issue requiring further searching and/or consideration by the Examiner. As such, entry of this Amendment is believed to be proper and is earnestly solicited.

It is noted that the amendments are made only to overcome the Examiner's non-statutory objections, and to more particularly define the invention and not for distinguishing the invention over the prior art, for narrowing the scope of the claims, or for any reason related to a statutory requirement for patentability.

It is further noted that, notwithstanding any claim amendments made herein, Applicant's intent is to encompass equivalents of all claim elements, even if amended herein or later during prosecution.

I. THE CLAIMED INVENTION

Applicant's invention, as disclosed and claimed, for example by independent claim 1, and similarly independent claim 10, is directed to a tape carrier type semiconductor device.

The device includes a flexible substrate on whose surface wiring is formed, and a driver circuit which is mounted on the flexible substrate and drives a device connected to the flexible substrate. The flexible substrate includes a first slit for releasing stress, the first slit having a connector for connecting parts of the first slit and separating the parts in a width-wise direction of the flexible substrate, and a second slit having no connector, for folding the flexible substrate. (See Page 6, line 12-Page 7, line 17; Page 8, lines 11-15; Page 9, line 27-Page 10, line 10; and Figures 1 and 6-9).

Similarly, for example, independent claim 13, is directed to a flexible substrate. The flexible substrate includes a first slit for releasing a stress, the first slit having a connector for connecting parts of the first slit and separating the parts in a width-wise direction of the flexible substrate, and on whose surface wiring having a predetermined pattern is formed, and a second slit having no connector, for folding the flexible substrate. (See above).

Conventional tape carrier-type semiconductors tend to have a stress-releasing slit, which does not include two sub-slits and a bridge, and may include a reinforcement plate. However, neither configuration prevents warpage caused by the different heat expansion coefficients of the resin on one surface of the flexible substrate and the solder resist applied to the other side of the flexible substrate. Thus, the warpage may prevent the tape carrier device, a liquid crystal display and the print substrate from being "desirably" connected. (See Page 1, line 22-Page 2, line 20;

and Figures 10A and 10B).

An aspect of the present invention includes the flexible substrate includes a first slit for releasing stress, the first slit having a connector for connecting parts of the first slit and separating the parts in a width-wise direction of the flexible substrate. The first slit is provided for releasing stress caused after the tape carrier-type semiconductor device is connected to a printed substrate or the like, and not provided for bending the tape carrier-type semiconductor device. The tape carrier-type semiconductor device provided with the first slit might be unnecessarily bent due to its own weight. If the tape carrier-type semiconductor device is bent, handling of the semiconductor device by an assembly apparatus, etc., might be disturbed. Therefore, the first slit is provided with a connector for preventing an unnecessary bending of the tape carrier-type semiconductor device, which is a significant feature of the present invention.

Indeed, the above configuration prevents "the warp of the tape carrier type semiconductor device" caused by the two different heat expansion coefficients of the resin and the solder resist exerted on the flexible substrate during manufacturing. In addition, this configuration reduces "mechanical stress on connection parts of the outer terminals and the respective print substrate," and thus prevents the outer terminal from detaching from the print substrate and the liquid crystal panel. (See Page 1, line 27-Page 2, line 3; Page 2, lines 24-26; Page 3, lines 9-13; Page 6, line 12-Page 7, line 17; Page 8, lines 11-15; Page 9, line 27-Page 10, line 10; and Figures 1 and 6-9).

As a result, a tape carrier type semiconductor device is easily manufactured and unlikely to warp.

II. THE PRIOR ART REJECTIONS

A. The § 103(a) Rejection of Muramatsu in view of Kang

Regarding claims 1-11, 13-15, 17, 18 and 21-35, first, the references, separately, or in combination, fail to teach, disclose or provide a reason or motivation for being combined. In particular, Muramatsu pertains to a mounted structure of an LSI tape carrier including deformable folding slits, and ribs, to reduce tensile force due to the length direction of the tape. (See Muramatsu at Abstract; and Detailed Description, Paragraphs [0003] and [0010]).

By contrast, Kang ("Kang") does not have the same aim as Muramatsu.

Kang discloses a tape carrier package and an LCD module to which the tape carrier packages are applied, which attempts to provide fine pitch leads and increase endurability due to stress caused by bending of the tape carrier package. (See Kang at Abstract; Column 1, lines 5-15 and 50-60).

Nothing within Kang, which attempts to provide fine pitch leads and increase endurability due to stress caused by bending of the tape carrier package, has anything to do with attempting to solve the problem of increased tensile force due to the length direction of the tape as disclosed in Muramatsu. Clearly, bending forces are forces exerted, for example, on a tape in a non-longitudinal, more perpendicular direction, which is different than a tensile force exerted on a tape in a longitudinal direction of the tape. Accordingly, bending forces are not the equivalent to tensile forces. Thus, Muramatsu teaches away from being combined with another invention, such as, Kang.

Therefore, one of ordinary skill in the art would not have combined these references, absent hindsight.

Second, even if combined, the references do not teach or suggest the features of independent claim 1, including that the flexible substrate includes a first slit for releasing stress, the first slit having a connector for connecting parts of the first slit and separating the parts in a width-wise direction of the flexible substrate as recited in independent claim 1, and similarly independent claims 10 and 13. (See Page 6, line 12-Page 7, line 17; Page 8, lines 11-15; Page 9, line 27-Page 10, line 10; and Figures 1 and 6-9).

Third, Applicant agrees with the Examiner that Muramatsu is deficient and "does not explicitly disclose a first slit for releasing stress, the first slit having a connector situated intermediate thereto for connecting both sides ends of the first slit to reduce warpage," let alone, more particularly, "the first slit having a connector for connecting parts of the first slit and separating the parts in a width-wise direction of the flexible substrate," as claimed by Applicant. (See Office Action, Page 3, lines 1-3; Page 5, Section 2, last two lines; and Page 6, Section 3, last three lines).

Applicant's first slit is provided for releasing stress caused after the tape carrier-type semiconductor device is connected to a printed substrate or the like, and not provided for bending the tape carrier-type semiconductor device. The tape carrier-type semiconductor device provided with the first slit might be unnecessarily bent due to its own weight. If the tape carrier-type semiconductor device is bent, handling of the semiconductor device by an assembly apparatus, etc., might be disturbed. Therefore, the first slit is provided with a connector for preventing an unnecessary bending of the tape carrier-type semiconductor device, which is a significant feature of the present invention.

Fourth, Kang does not make up for the deficiencies of Muramatsu. Instead, Figures 1-3 of Kang only disclose a tape carrier package 100 comprised of a solder resist 30 with a first slit 16 comprised of two slits 16a and 16b, "which are selectively formed along the width direction of the base film 10." Applicant respectfully asserts that the Office Action mischaracterizes Kang because Kang only teaches a first slit without a connector for connecting parts of the first slit.

Even assuming arguendo that Kang teaches a first slit with a connector, which it does not, Kang, at best, teaches that the slits 16a and 16b have a connector situated intermediate the lateral sides, which extends in a longitudinal-wise direction of the tape carrier package 100, including solder resist 30 (what the Examiner attempts to analogize to Applicant's connector for connecting parts of the first slit and separating the parts in a width-wise direction of the flexible substrate).

To the contrary, Kang clearly discloses that the two slits 16a and 16b each have non-end sides, i.e., lateral sides, which are parallel to each other and separated by the base film 10, and extend in a longitudinal-wise direction of the taper carrier package 100. Accordingly, this structure is consistent with Kang's attempt to reduce stress during bending and decrease cracks at a boundary 36 of the solder resist 30 and the output outer leads 24. Thus, the base film 10 is situated between the lateral sides of the two slits 16a and 16b, where the base film 10 extends in a longitudinal-wise direction of the tape carrier package 100. (See Office Action, Page 3, 1st Paragraph; Page 6, 1st Paragraph; Page 7, 1st Paragraph; and Kang, Column 3, line 53-Column 4, line 16).

In contrast, Applicant teaches that the first slit 7 includes a connector, i.e., a bridge, 9 for

connecting parts of the first slit and separating the parts in a width-wise direction of the flexible substrate to reduce warpage, whereas Kang, as discussed above, only teaches that the base film 10, which extends in a longitudinal-wise direction of the tape carrier package 100, is situated intermediate the sides of the two slits 16a and 16b.

Indeed, for emphasis, Applicant's first slit 7 is a thermal stress-releasing slits, for example as recited in claim 30, which reduce warpage of the tape carrier, due to "a difference in heat expansion coefficients" of the solder resist and resin each formed on a separate surface of the flexible substrate. Thus, Applicant's configuration prevents the outer terminals from being detached from the print substrate and the LCD.

However, Kang does not disclose or suggest that the two slits 16a and 16b reduce thermal stress but instead only reduce mechanical bending stresses.

Consequently, the conventional Muramatsu and Kang structures are unsuitable for achieving at least one object of the invention, which includes reducing "the warp of the tape carrier type semiconductor device" caused by the two different heat expansion coefficients of the resin and the solder resist exerted on the flexible substrate during manufacturing, and thus preventing the outer terminal from detaching from the print substrate and the liquid crystal panel. Therefore, the tape carrier type semiconductor device is easily manufactured and unlikely to warp. (See Page 1, line 27-Page 2, line 3; Page 2, lines 24-26; Page 3, lines 9-13; Page 6, line 12-Page 7, line 9; Page 8, lines 11-15; Page 9, line 27-Page 10, line 10; and Figures 1 and 6-9).

For at least the reasons outlined above, Applicant respectfully submits that neither Muramatsu nor Kang disclose, teach or suggest all of the features of the independent claims 1, 10

and 13, and related dependent claims 2-9, 11, 14, 15, 17, 18, 22, 23, 25, and 28-35, which are patentable not only by virtue of their dependency from their respective independent claims, but also by the additional limitations they recite.

For the reasons stated above, the claimed invention, and the invention as cited in independent claim 1, and similarly independent claims 10 and 13, should be fully patentable over the cited references.

B. The § 103(a) Rejection of Muramatsu in view of Kang, and further in view of Toyosawa, et al.

Regarding claims 21, 24, 26 and 27, first, the references, separately, or in combination, fail to teach, disclose or provide a reason or motivation for being combined. In particular, as indicated above, Muramatsu pertains to a mounted structure of an LSI tape carrier including deformable folding slits, and ribs, to reduce tensile force due to the length direction of the tape. (See Muramatsu at Abstract; and Detailed Description, Paragraphs [0003] and [0010]).

By contrast Kang does not have the same aim as Muramatsu as indicated above.

Kang only discloses a tape carrier package and an LCD module to which the tape carrier packages are applied, which attempts to provide fine pitch leads and increase endurability due to stress caused by bending of the tape carrier package. (See Kang at Abstract; Column 1, lines 5-15 and 50-60).

By contrast, Toyosawa, et al. ("Toyosawa") does not have the same aim as Muramatsu or Kang.

Toyosawa discloses a tape carrier package and an LCD using a copper wiring pattern,

which attempts to increase flexibility and reduce disconnection in the metal wiring pattern upon packaging for use with the LCD. (See Toyosawa at Abstract; Column 1, Paragraph [0001]; and Column 4, Paragraph [0043] and [0044]).

Nothing within Toyosawa, which pertains to increased flexibility and reduced disconnection in the copper wiring pattern, has anything to do with fine pitch leads and increasing durability due to stress caused by bending of the tape carrier package as disclosed in Kang. Further, Toyosawa has nothing to do with attempting to solve the problem of increased tensile force due to the length direction of the tape as disclosed in Muramatsu. Thus, Muramatsu teaches away from being combined with another invention, such as, Kang or Toyosawa.

Therefore, one of ordinary skill in the art would not have combined these references, absent hindsight.

Second, even if combined, the references do not teach or suggest the features of independent claim 1, including that the flexible substrate includes a first slit for releasing stress, the first slit having a connector for connecting parts of the first slit and separating the parts in a width-wise direction of the flexible substrate as recited in independent claim 1. (See Page 6, line 12-Page 7, line 17; Page 8, lines 11-15; Page 9, line 27-Page 10, line 10; and Figures 1 and 6-9).

Third, neither Muramatsu nor Kang, as discussed above, disclose, teach or suggest the above feature of Applicant's invention.

Fourth, the Examiner clearly indicates that neither Muramatsu nor Kang disclose, teach or suggest that "the flexible substrate comprises at least one of a polyimide resin film, an organic polymer film, a polyamide resin film, a polyester resin film and a composite film," for example,

as recited in claim 21. The Examiner also indicates that neither Muramatsu nor Kang disclose, teach or suggest that the flexible substrate comprises a resin on a first side of the flexible substrate, the resin including a first heat expansion coefficient," for example, as recited in claim 26. Further, as indicated, neither Muramatsu nor Kang disclose, teach or suggest that "the flexible substrate comprises a solder resist on a second side of the flexible substrate, the solder resist including a second heat expansion coefficient," for example, as recited in claim 27. (See Office Action at Page 4, 4th Paragraph-Page 5, 1st Paragraph).

Fifth, Toyosawa does not make up for the deficiencies of either Muramatsu or Kang.

Toyosawa does not disclose a feature of claim 1, including that the flexible substrate includes a first slit for releasing stress, the first slit having a connector for connecting parts of the first slit and separating the parts in a width-wise direction of the flexible substrate. Accordingly, Toyosawa also does not disclose the features of claims 21, 24, 26 and 27 of Applicant's invention. Thus, Applicant traverses the assertion in the Office Action that Toyosawa includes such features.

Instead, Figure 1(b) of Toyosawa discloses a tape carrier package 23 and an LCD comprised of a copper wiring pattern, which includes "a pair of slits 25 that are through holes" where solder resist 30 covers the slits to form bending portions. (See Application, Page 2, Paragraph [0021]; Page 8, Paragraphs [0113] and [0119]; Page 9, Paragraph [00135]; and Figures 1(b), 6, 12(a) and 12(b)). The slits are a continuous rectangular shape oriented perpendicular to the length of the tape carrier without any connector for connecting parts of the slit and separating the parts in a width-wise direction of the flexible substrate. Thus, the slits are

bending portions. (See Office Action, Page 4- Page 5; and Toyosawa at Abstract; Column 1, Paragraph [0001]; Column 4, Paragraph [0043] and [0044]; and Column 16, Paragraph [0119]).

Accordingly, Toyosawa attempts to provide a significant amount of flexibility through this structure while attempting to reduce disconnection in the metal wiring pattern upon packaging for use with the LCD. Applicant respectfully asserts that the Office Action mischaracterizes Toyosawa because Toyosawa only teaches slits used as through holes but does not disclose, teach or suggest, including that the first slit having a connector for connecting parts of the first slit and separating the parts in a width-wise direction of the flexible substrate, let alone, the first slit comprises a stress-releasing slit as recited in Applicant's invention.

Toyosawa teaches a copper wiring pattern with slits used as through-holes without any print substrate whereas Applicant teaches the flexible substrate is connected to a print substrate where the first slit is a stress-releasing slit adjacent to a driver circuit and a print substrate. Further , Toyosawa only teaches that the slits are continuous without any intermediate connector whereas Applicant teaches that the first slit, i.e., the stress releasing slit, has a connector for connecting parts of the first slit and separating the parts in a width-wise direction of the flexible substrate.

Again, for emphasis, Applicant's first slit is provided for releasing stress caused after the tape carrier-type semiconductor device is connected to a printed substrate or the like, and not provided for bending the tape carrier-type semiconductor device. The tape carrier-type semiconductor device provided with the first slit might be unnecessarily bent due to its own weight. If the tape carrier-type semiconductor device is bent, handling of the semiconductor

device by an assembly apparatus, etc., might be disturbed. Therefore, the first slit is provided with a connector for preventing an unnecessary bending of the tape carrier-type semiconductor device, which is a significant feature of the present invention.

Consequently, the conventional Muramatsu, Kang and Toyosawa structures are unsuitable for achieving at least one object of the invention, which includes reducing "the warp of the tape carrier type semiconductor device" caused by the two different heat expansion coefficients of the resin and the solder resist exerted on the flexible substrate during manufacturing, and thus preventing the outer terminal from detaching from the print substrate and the liquid crystal panel. Therefore, the tape carrier type semiconductor device is easily manufactured and unlikely to warp. (See Page 1, line 27-Page 2, line 3; Page 2, lines 24-26; Page 3, lines 9-13; Page 6, line 12-Page 7, line 9; Page 8, lines 11-15; Page 9, line 27-Page 10, line 10; and Figures 1 and 6-9).

Finally, Applicant traverses the assertion in the Office Action that the warpage percentage of the tape carrier as recited in claims 24 is not critical and can be determined by routine experiment. Based on Applicant's configuration, which includes a stress releasing slit with a bridge, the amount of warp is equivalent to 4.8% of the length of the tape carrier device compared to a conventional device (i.e, not Applicant's configuration), where the warpage is approximately 30%. This reduction in warpage is more than a 100% reduction. Accordingly, this result is particularly significant, as indicate above, as the reduced warpage prevents the outer terminal from detaching from the print substrate and the liquid crystal display while simplifying the manufacturing process as recited in the specification. (See Application, Page 7, line 26-Page

8, line 15).

Contrary to the assertion in the Office Action, since none of Muramatsu, Kang, Toyosawa, nor the conventional art teach or suggest Applicant's invention, one of ordinary skill in the art could not simply produce Applicant's reduced warpage of only 4.8% by simple experimentation, particularly as none of Muramatsu, Kang or Toyosawa are focused on reducing warpage due to thermal stress. Indeed, none of the references disclose or teach any reduced warpage percentage, let alone, a reduced warpage of 4.8 percent. Thus, none of the references teaches or suggests Applicant's invention, including the feature of claim 24.

For at least the reasons outlined above, Applicant respectfully submits that none of Muramatsu, Kang or Toyosawa teach or suggest all of the features of the independent claim 1, and related dependent claims 21, 24, 26 and 27, which are patentable not only by virtue of their dependency from their respective independent claims, but also by the additional limitations they recite.

For the reasons stated above, the claimed invention, and the invention as cited in independent claim 1, is fully patentable over the cited references.

IV. FORMAL MATTERS AND CONCLUSION

In view of the foregoing, Applicant submits that claims 1-11, 13-15, 17, 18 and 21-35, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the

Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

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CERTIFICATION OF TRANSMISSION

I certify that I transmitted the enclosed Amendment under 37 CFR §1.116 to Examiner Khiem D. Nguyen via facsimile to (703) 872-9306 on June 4, 2004.

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